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# Pesticides and organic farming - a last resort

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Organic farming minimises pesticide use but does not currently eradicate it, a point which is sometimes made a great deal of by critics of organic food. This paper puts pesticide use on organic farms in context and demonstrates that a widespread conversion to organic farming would reduce, virtually eliminating, pesticide use in the UK.

- 31,000 tonnes of pesticides are applied to UK farmland each year. Soil Association organic farms account for 0.03% of this (10 tonnes).
- Soil Association organic growers in the UK can use only four pesticides (copper, rotenone, soft soap and sulphur) for specified purposes. The vast majority is used on potatoes, most of the remainder is used on orchard fruit.
- In 2006, copper and derris were used by 63 Soil Association organic growers (3% of certified producers) on 709 hectares of organic land, representing 2% of Soil Association fully organic cropped land (0.3% total fully organic land).
- If all UK farmland switched to organic, this would result in a 98% reduction in pesticide use.

## 1. Controlling pests and diseases on organic farms

Organic farming systems rely on prevention rather than cure. The incidence of pest and disease damage in organic systems is reduced using good crop rotations, resistant varieties, maintaining biodiversity and optimum crop health (for further information see 'Pest and disease control in organic farming').

Occasionally, organic farmers may have to use pesticides, and the primary reasons are listed below. When this happens a limited number of pesticides can be used as a last resort. In the UK, organic farmers can use up to seven pesticides (ACOS, 2005), only four of these are allowed on Soil Association farms, mainly to control insect pests and fungi - see Table 2. No herbicides (weedkillers) are permitted.

**i. There can be a lack of suitable plant varieties for organic growers.** Research and development has focused on non-organic farming, so many plant varieties are designed for use with pesticides. Research into organic disease-resistant varieties has been neglected but more varieties, like blight-resistant potatoes, are now on the market.

**ii. Organic farmers are currently a small minority in an intensively farmed environment.** Most organic farms have non-organic neighbours where monocultures and pesticide sprays leave little space for wildlife and natural predators. This can make it more difficult for organic farmers to create fully balanced systems that keep pests and diseases within ecological limits.

**iii. Many multiple retailers demand increasingly strict standards for cosmetic appearance** and uniformity from their suppliers. There is more variation in the size and

shape of organic food which means that growers can have crops rejected if apples are blemished or carrots are the 'wrong' size. The sooner people value character and taste over uniformity, the fewer pesticides will be used on organic farms.

iv. In exceptional circumstances, pests and diseases can 'over-ride' an organic system and cause damage. For example, **unusual weather conditions** can favour a particular pest and disrupt the balance of biodiversity.

## 2. What can be used?

Four pesticides are allowed on Soil Association organic farms in the UK: sulphur, soft soap, copper and rotenone. They are either of natural origin (rotenone and soft soap) or simple chemical products (copper and sulphur) compared to the more complex substances typically used as pesticides in non-organic farming. They break down easily in the environment and are unlikely to leave residues in food. Copper and rotenone are restricted, which means that they can only be used with consent by the certification body where the farmer provides evidence of a threat to the crop and no alternatives are available. In addition, the Soil Association is consulting whether to extend this restriction to soft soap and sulphur. (Additional pesticides allowed by other UK certifiers are Pyrethroids (deltamethrin or lambda-cyhalothrin only), Iron (III) orthophosphate and paraffin oil - the latter two are restricted.)

i. **Copper compounds** are effective against some fungal diseases, particularly potato blight which is widespread in the UK and can have devastating effects. It is mainly used on one crop, potatoes, and some orchards.<sup>1</sup>

ii. **Rotenone** can be used to control insects, such as aphids and sawfly, on soft fruit as well as some brassicas and glasshouse crops. It is a naturally occurring chemical extracted from the roots of tropical plants and is sometimes referred to as derris.<sup>1</sup>

iii. **Sulphur** is mainly used in orchards to control fungal diseases like scab, as well as some insects.<sup>2</sup>

iv. **Soft soap** is derived from fatty acid potassium soap of natural plant origin (pine trees) and is used to control insects such as aphids on some fruit and glasshouse crops.<sup>2</sup>

<sup>1</sup> Copper and rotenone are 'restricted' and can only be used where the need is recognised by the Soil Association.

<sup>2</sup> Farmers do not require prior permission to use sulphur or soft soap, however, they can only be used where there is an actual threat to the crop, i.e. not preventively. They will be placed under 'restricted' status in the future.

Organic growers are also encouraged to explore the use of licensed, naturally occurring **biological control agents**, such as *Bacillus thuringensis* (also known as Bt). Biological control uses predators or parasites of pests which are released into the crop and have been used with considerable success, particularly in glasshouses. (Biological control agents are classified as 'pesticides' by the Government.)

## 3. How much are they used?

- Pesticides are mainly used on one crop, potatoes, which accounts for 82% of copper. Some copper and sulphur are also used on orchard fruit like apples. All other organic arable farming in the UK has no need, and no possibility, of using pesticides.

- Table 1 shows that around ten tonnes of pesticides are used on Soil Association UK organic farms annually. In 2006, this included 2.2 tonnes of copper, 1.7kg of derris, 2 tonnes of soft soap and an estimated less than 5 tonnes of sulphur. Copper and derris were applied by 3% of Soil Association farmers (63) on 2% of organic cropped land (709 hectares).
- Pesticides used on Soil Association organic farms account for 0.03% of total pesticides in the UK. In comparison, 447 pesticides can be used in non-organic farming (BCPC, 2006) where 31,000 tonnes are applied every year (Central Science Laboratory, 2006).
- If all UK farmland converted to organic production, this would produce a 98% drop in pesticide use.

In 2006, around 10 tonnes of pesticides were applied on Soil Association farms in the UK. On average, 0.15kg were applied per hectare to cropped Soil Association land (although the vast majority was unsprayed) compared to 7kg/ha on non-organic cropped land. If all farmland in the UK converted to organic then total annual pesticide use would be approximately 669 tonnes, a 98% reduction on the current total of 31,000 tonnes (0.000154 tonnes x 4,340,000 ha of total cropped land = 669 tonnes).

**Rotenone** was used by just five growers on 36 hectares in 2006. An estimated total of 1.71kg of rotenone was used to control insects on crops which would otherwise be destroyed. When used, it is typically applied on soft fruit like gooseberries and blackcurrants, as well as brassicas like cauliflowers and broccoli. In large quantities, it can have harmful effects on beneficial insects as well as aquatic life. However, it is unlikely to pose any risks in the minute quantities used by organic growers. In addition, rotenone is highly photosensitive and breaks down rapidly in the environment.

**Copper** compounds are used to control fungi on some crops (copper sulphate, copper oxychloride and copper ammonium carbonate). Copper is an element that occurs naturally in the environment, our bodies, and our food. At very high levels, copper can be toxic to worms. However, many soils in the UK are actually copper deficient and the limited quantities of copper applied in organic farming are unlikely to have any adverse environmental impacts. In potato production, where 82% of copper in organic farming is used, good crop rotations should avoid copper accumulation in the soil. However, where crops cannot be rotated, such as orchards and vines, there may be a risk of copper build up in the soil. Therefore, the Soil Association is currently examining alternatives to copper for vines and other crops. In 2006, 58 Soil Association organic farmers applied a total of 2.2 tonnes of copper to crops. The vast majority of copper (1.8 tonnes, 82%) was applied to potatoes. Ten per cent of total copper was applied to orchards (226kg/0.23 tonnes) with smaller amounts were used on onions (91kg) and vines (57kg). In some cases, growers apply copper more than one during a year, for example, to treat potato blight. Total annual copper use for organic growers in Europe must not exceed 6kg/ha (the limit was previously 8kg/ha until 1 January 2006). This 2.2 tonnes accounts for less than 0.4% of the total 706 tonnes of copper applied to soils in England and Wales each year (Nicholson et al., 2003). The vast majority of copper applied to soils is via animal manure (642 tonnes) as well as 53 tonnes applied directly as a soil conditioner by non-organic farmers.

**Table 1 Pesticide usage on UK Soil Association organic farms, 2006**

	No. of licensees	Area treated (ha) <sup>3</sup>	Estimated quantity applied (tonnes)
<b>Copper</b>	58	987	2.2
<b>Rotenone</b>	5	50	0.002
<b>Soft soap</b> <sup>1</sup>	No data	No data	2.0
<b>Sulphur</b> <sup>2</sup>	No data	No data	<5

Source: Soil Association Certification Ltd, 2007

#### Notes

<sup>1</sup> Based on data from manufacturers, it is estimated that less than two tonnes of soft soap are used by organic farmers annually.

<sup>2</sup> Estimate since sulphur use is not currently recorded.

<sup>3</sup> Area treated<sup>1</sup> does not include repeat applications on the same fields.

It is difficult to estimate the level of sulphur and soft soap since individual applications are not recorded. Data from the manufacturers indicates that 16,000 litres of **soft soap** solution are sold in the UK annually, accounting for approximately 8.1 tonnes of the active ingredient fatty acid potassium salt (505g per litre). It is estimated that less than two tonnes of the active ingredient are applied on organic crops in the UK each year.

Like copper, **sulphur** is also a plant nutrient and is mostly limited to use as a fungicide in orchards as well as controlling some insects. There is currently little data available for total quantities applied, however, the Soil Association hopes to record individual sulphur applications from 2007 onwards. It is estimated that less than five tonnes of sulphur are used annually on Soil Association farms. The use of sulphur is widespread in non-organic farming where an estimated 87,000 tonnes are applied each year as a fertiliser (based on Defra, 2003 and 2004). In addition, 10,000 tonnes of sulphuric acid are used by non-organic farmers in Britain to kill the foliage on potato crops (Garthwaite et al., 2002).

#### 4. Will they leave residues in my food?

Organic food is the best way of reducing, if not eliminating, pesticides in your diet. Pesticides are not routinely used on organic farms and a closer look at pesticide use on non-organic farms puts this into perspective. In comparison, non-organic farmers have access to 447 pesticides (BCPC, 2006), many of which can be highly toxic to the environment. According to Government data, 44% of non-organic fruit and vegetables samples contained pesticides (Pesticide Residue Committee, 2006) and there is evidence to suggest that dietary exposure to pesticides used in non-organic farming, including long-term exposure and multiple residues, are linked to human health risks.

Unlike many pesticides used in non-organic farming, these pesticides are unlikely to pose a risk to human health or the environment. Soft soap, rotenone, and paraffin, plant and mineral oils all break down quickly in the environment, and so should not be a threat to human health or the wider environment. These substances do not leave systemic residues in food - they do not penetrate beneath the surface of plants - and can be easily washed away. In addition, copper used on potatoes does not leave residues in food since it is applied to the leaves and not the potato tuber. Ongoing research from the University of Newcastle indicates that copper fungicides do not have a detrimental effect on potato composition or soil minerals (Juntharathap, 2005). This is because copper and other minerals are taken up the potato tuber via the soil and not via the leaves.

## 5. Can organic farmers use any other products to protect their crops?

Organic farmers can also use a number of products to protect crops which do not act like pesticides - they do not kill insects or other living organisms. These products, shown in Table 3, act in a variety of ways, including acting as a physical barrier to pests or attracting pests away from crops without killing them. In addition, there are a number of other pesticides permitted in UK baseline organic standards which are *not* used in the UK because they are not currently approved for use by the Pesticide Safety Directorate (PSD). Substances listed in Regulation (EEC) 2092/91 may be used on organic crops grown in other EU countries where permitted under national legislation, for example, where due to different environmental conditions. These pesticides are azadirachtin (neem tree extract), quassia (extracted from the shrub, *Quassia amara*), lime sulphur (calcium polysulphide), lecithin, and plant oils (e.g. mint oil, pine oil, caraway oil). The natural pesticide, pyrethrum, is also allowed under restricted circumstances in UK baseline and Soil Association standards and was approved for use in the UK by the PSD in December 2005. This insecticide is based on pyrethrins extracted from the Chrysanthemum flower ( *Chrysanthemum cinerariaefolium* ), possibly containing a synergist. The Soil Association is not aware of any licensed organic farmers currently using pyrethrum and is monitoring any future use of pyrethrum by its growers.

## 6. What is the Soil Association doing?

Organic standards are at the heart of the Soil Association's work as they put into practice our aims and philosophy. The Soil Association's Standards Committees are continually involved in developing our standards. This is a vital activity, enabling them to maintain their pioneering nature and to reach ever closer to the aspirational organic principles. As a result the list of pesticides which can be used under these standards is continually under review with a view to further restricting and eventually eliminating the need for these wherever possible. For example, the Horticulture Standards Committee has recommended that the use of sulphur and soft soap should also be 'restricted', so growers will have to justify the need for use prior to using them in the future. This proposal is currently out to consultation until July 2007. The Soil Association is also investigating ways of phasing out copper, including resistant varieties and more benign alternatives.

**Table 2 Pesticides allowed in UK organic farming - comparison of minimum UK standards (ACOS) and the Soil Association**

Product name	Description, conditions	SA	ACOS
<b>A. Substances of crop or animal origin</b>			
Rotenone (extracted from Derris spp., Lonchocarpus spp. & Terphrosia spp.)	Insecticide	R	R
Fatty acid potassium salt (soft soap). Derived from bone material or palm oil.	Insecticide	P	P
<b>B. Synthesised substances</b>			
Sulphur	Fungicide, acaricide	P	P
Copper (copper sulphate, copper oxychloride, copper ammonium carbonate)	Fungicide. Maximum of 6kg/ha per year The maximum limit on soil copper levels is 50ml/kg or 110ka/ha	R	R
Paraffin oil	Insecticide, acaricide	x	P
Iron (III) orthophosphate		x	P
Pyrethroids (only deltamethrin or lambdacyhalothrin) - in traps and dispensers only	Insecticide, in traps with attractants. Only against <i>Batrocera oleae</i> & <i>Ceratitis capitata</i> wied	x	R
<b>C. Biological control agents</b>			
Micro-organisms (bacteria, viruses & fungi) e.g. <i>Bacillus thuringensis</i> , Granulosis virus, etc	Only products which are not genetically modified according to EU Directive 90/220/EEC. SA standards require only licensed and naturally occurring organisms.		

**Notes**

R = 'Restricted'. Can only be used where need is recognised by a certification body and permission is granted where there is evidence of a threat to the crop  
P = Permitted in UK organic standards. X = Not permitted by the Soil Association.  
This table applies to organic production in the UK. Additional substances listed in Regulation (EEC) 2092/91 may only be used on organic crops grown in the EU where they are permitted by domestic legislation.

**Table 3 Other methods of plant protection permitted in organic production - barriers and attractants**

Product name	Description, conditions
Beeswax	Pruning agent / protectant for controlling fungi
Diammonium phosphate	Only as an attractant in traps
Gelatine	Barrier for controlling insect pests
Hydrolised proteins	Only as an insect attractant with other appropriate permitted products
Quartz sand	Repellent against insect pests
Sticky fly traps	Only those free from non-permitted insecticides

**Note:** These products are permitted for use in the UK in both Soil Association and ACOS organic standards.

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How can I support the work of the Soil Association?

The Soil Association is a membership charity, we urgently need your support to continue our work. As public support for the Soil Association continues to grow, our ability to influence the thinking and policies of government and big business grows with it. In this way we help to develop a truly healthy and sustainable future. Join us today and help us to continue campaigning for sustainable agriculture and organic food. You can join the Soil Association on our website, over the phone or by writing to us.

## Further Reading

Please see the Soil Association website library, <http://www.soilassociation.org/library>, for more information

**Soil Association** Campaigning for organic food and farming and sustainable forestry  
South Plaza, Marlborough Street, Bristol BS1 3NX  
T: 0117 314 5000 F: 0117 314 5001 E: [info@soilassociation.org](mailto:info@soilassociation.org)  
[www.soilassociation.org](http://www.soilassociation.org)

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